

CLAIMS

1. A system for designing joint artificial implant components comprising:
 - an anthropometric data analyzer for identifying a plurality of geometric dimensions and a range of values for the identified dimensions;
 - an implant model generator for generating at least one set of model data representative of the identified geometric dimensions and a group of values with the range of values for the identified dimensions; and
 - a kinematic model simulator for incorporating a set of model data in a kinematic model of a joint so that the kinematic model simulator generates dynamic response data corresponding to a set of model data whereby the dynamic response of an artificial implant corresponding to the set of model data may be evaluated.
2. The system of claim 1 further comprising:
 - a dynamic response data analyzer to generate differential dimensional data for modifying the one set of model data in response to the dynamic response data indicating that implantation of the artificial implant corresponding to the set of model data produces a conditional parameter in the kinematic model of the kinematic model simulator.
3. The system of claim 2 wherein the implant model generator incorporates the differential dimensional data to generate a second set of model data;

the kinematic model simulator incorporates the second set of model data within the kinematic model to generate dynamic response data; and

the dynamic response data analyzer determines whether additional differential dimensional data are generated for modification of the second set of model data.

4. The system of claim 2 wherein the dynamic response data analyzer determines whether a set of model data that generates dynamic response data meets an acceptance parameter.
5. The system of claim 1 wherein the anthropometric data analyzer receives computed tomography (CT) data for analysis.
6. The system of claim 1 wherein the anthropometric data analyzer receives magnetic resonance image (MRI) data for analysis.
7. The system of claim 1 wherein the anthropometric data analyzer is a static image data analyzer.
8. The system of claim 7 wherein the static image data analyzer is a computer aided design (CAD) program that enables an operator to select a feature in static image data for defining a geometric dimension and to measure the selected geometric dimension.

9. The system of claim 7 wherein the static image data analyzer is an adaptation of a computer program that measures terrain topographic features.
10. The system of claim 1 the system further comprising:
a patient model emulator for generating emulation force parameters to be used by the kinematic model emulator.
11. The system of claim 10 wherein the patient model emulator uses image data of a joint in motion to generate the emulation force parameters.
12. The system of claim 11 wherein the patient model emulator uses fluoroscopic image data of a joint in motion to generate the emulation force parameters.
13. The system of claim 1 wherein the kinematic model simulator is a computer program that applies emulation force parameters to an implant model to generate dynamic response data.
14. The system of claim 12 wherein the dynamic response data analyzer compares the dynamic response data generated by the kinematic model

simulator to the fluoroscopic data used to generate the emulation force parameters to evaluate the set of model data.

15. The system of claim 12 wherein the dynamic response data analyzer receives motion data in the time domain from the kinematic model simulator.

16. The system of claim 14 wherein the dynamic response data analyzer generates a set of differential data to alter the set of model data.

17. The system of claim 1 further comprising:

a motion data analyzer for analyzing joint motion image data studies to group the studies into sets that are correlated by the degree of motion demonstrated during a particular activity, and

the anthropometric data analyzer identifies a plurality of geometric dimensions and a range of values for the identified dimensions for the joints imaged in a set.

18. A method for designing joint artificial implant components comprising:

analyzing anthropometric image data to identify a plurality of geometric dimensions and a range of values for the identified dimensions;

generating at least one set of implant model data representative of the identified geometric dimensions and a group of values with the range of values for the identified dimensions; and

incorporating a set of implant model data in a kinematic simulation of a joint to generate dynamic response data corresponding to the set of implant model data whereby the dynamic response of an artificial implant corresponding to the set of implant model data may be evaluated.

19. The method of claim 18 further comprising:

generating differential dimensional data for modifying the set of model data in response to the dynamic response data indicating that the artificial implant corresponding to the set of implant model data produces a conditional parameter in the kinematic model.

19. The method of claim 19 further comprising:

incorporating the differential dimensional data to generate a second set of implant model data;

incorporating the second set of implant model data within the kinematic model to generate dynamic response data; and

determining whether additional differential dimensional data are generated for modification of the second set of implant model data.

20. The method of claim 19 further comprising:

determining whether a set of implant model data that generates dynamic response data meets an acceptance parameter.

21. The method of claim 18 wherein the anthropometric data analysis includes analysis of computed tomography (CT) data.

22. The method of claim 18 wherein the anthropometric data analysis includes analysis of magnetic resonance image (MRI) data.

23. The method of claim 18 wherein the anthropometric data analysis includes analysis of three dimensional image data.

24. The method of claim 18 wherein the image data analysis includes enabling an operator to select a feature in static image data for defining a geometric dimension and measuring the selected geometric dimension.

25. The method of claim 23 wherein the three dimensional data analysis includes using a computer program that measures terrain topographic features.

26. The method of claim 18 wherein the implant model data generation includes modifying the set of implant model data with image data of a joint physiology in dynamic motion.
27. The method of claim 26 wherein the implant model data modification includes modification using dynamic motion image data of a joint compiled by taking fluoroscopic images of a joint in motion.
28. The method of claim 18 wherein the kinematic model simulation includes applying emulation force vectors to the implant model data.
29. The method of claim 28 wherein the kinematic model simulation includes:
generating motion response data in the time domain.
30. The method of claim 28 wherein the dynamic response data analysis includes identifying a conditional parameter.
31. The method of claim 29 wherein the dynamic response data analysis includes generating a set of differential dimensional data from the identified conditional parameter to alter the model data so that the likelihood of the conditional parameter occurring from an implantation of an artificial joint corresponding to the set of model data is reduced.

32. A system for developing solid model data from joint motion image data comprising:

a motion data analyzer for analyzing joint motion image data to group image studies according to range of motion and activity;

an anthropometric data analyzer for generating geometric dimensions and measurement ranges for the geometric dimensions, the geometric dimensions and measurement ranges corresponding to the image studies in at least one group of image studies;

an artificial implant model generator for generating an artificial implant model from the geometric dimensions and measurement ranges; and

a kinematic model simulator.

33. The system of claim 32 wherein the motion data analyzer receives fluoroscopic image data of a plurality of joints in motion.

34. The system of claim 32 wherein the motion data analyzer performs frequency distribution analysis on the joint motion image data to group the joint motion image studies into sets that are correlated by the degree of motion demonstrated during a particular activity.

35. The system of claim 34 wherein the anthropometric data analyzer determines whether one or more geometric dimension groupings correlate to the joints depicted in the image studies associated with a motion grouping.
36. The system of claim 35 wherein the motion data analyzer compares the motion versus time response data received from the kinematic model simulator with the motion versus time data from at least one of the joint motion image studies correlated to the motion grouping that was used to develop the artificial implant model.
37. The system of claim 36 wherein the motion data analyzer generates a set of differential data in response to the comparison indicating that the artificial implant model was unable to achieve normal joint motion.

38. A method for developing solid model data from joint motion image data comprising:
- analyzing joint motion image data to group image studies according to range of motion and activity;
 - generating geometric dimensions and measurement ranges for the geometric dimensions, the geometric dimensions and measurement ranges corresponding to the image studies in at least one group of image studies;
 - generating an artificial implant model from the geometric dimensions and measurement ranges; and
 - simulating a kinematic model using the generated artificial implant model.
39. The method of claim 38 wherein the analysis of the joint motion image data includes receiving fluoroscopic image data of a plurality of joints in motion.
40. The method of claim 38 wherein the analysis of the joint motion image data includes performing frequency distribution analysis on the joint motion image data; and
- grouping the joint motion image studies into sets that are correlated by the degree of motion demonstrated during a particular activity.

41. The method of claim 40 wherein the analysis of anthropometric data includes determining whether one or more geometric dimension groupings correlate to the joints depicted in the image studies associated with a motion grouping.
42. The method of claim 41 wherein the analysis of joint motion data includes comparing the motion versus time response data received from the kinematic model simulator with the motion versus time data from at least one of the joint motion image studies correlated to the motion grouping that was used to develop the artificial implant model.
43. The method of claim 42 wherein the analysis of the joint motion data includes generating a set of differential data in response to the comparison indicating that the artificial implant model was unable to achieve normal joint motion.